Super-spreading Events and Contribution to Transmission of MERS, SARS, and COVID-19

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All authors have no conflicts of interest

This is the author's manuscript of the article published in final edited form as:

Al-Tawfiq, J. A., & Rodriguez-Morales, A. J. (2020). Super-spreading events and contribution to transmission of MERS, SARS, and COVID-19. Journal of Hospital Infection. https://doi.org/10.1016/j.jhin.2020.04.002

There is no clear definition for the term “super-spreader” or “super-spreading event”. The World Health Organization (WHO) refers to a super-spreader as a patient (or an event) in which a significant number of individuals become infected from one event that is more than usual. In the SARS situation, a super spreading event was defined as the transmission of SARS to at $\geq$ 8 contacts [1], and other authors defined this as individuals infecting an unusually large number of secondary cases [2]. A super-spreading event could merely be defined as an event where one patient infects far more people than an average patient does, which is estimated by the Ro.

Super-spreading events during SARS, MERS, and COVAD:

A super spreading event was recognized during the SARS outbreak when a flight attendant infected more than 100 patients in Singapore [3]. In the situation of MERS-CoV, one patient infected 82 individuals during his course of illness during an outbreak in South Korea [4]. This index case in the Republic of Korea resulted in 27 secondary cases, and, one of these cases infected an additional 24 tertiary cases, and a third patient caused 73 tertiary cases [5].

In the current COVID-19 pandemic, the third British man contracted SARS-CoV-2 at a conference in Singapore and then travelled to France and stayed with family in a ski chalet (Alpine resort). Five of his contacts tested positive [6]. In South Korea, 37 cases were linked to the religious sect, the Shincheonji Church of Jesus.

What explains a super-spreading event?

There are multiple explanations for the occurrence of super-spreading events and include immune suppression, increased disease severity and viral load, asymptomatic individuals, and extensive social interactions [7].

Individuals with immune suppression may shed virus at a higher level and for a longer duration and may have atypical presentation [8]. Patients with severe disease may have higher viral loads and thus are more likely to shed higher infectious doses. In a study from MERS-CoV, critically ill patients had a longer duration of transmission and shedding of the virus [9].

Another explanation is that super-spreading event may occur because individuals with no or mild symptomatic may go unrecognized, and no measures are implemented. Such cases would then lead to widespread dissemination of the virus before recognition and application of infection control measures. The contribution of asymptomatic individuals to the spread of coronavirus is not well known. Serologic testing in the case of SARS-CoV showed a positive rate of 13% in asymptomatic individuals compared 82% in severe disease and 4% in those with mild symptoms [10]. One study indicated that an asymptomatic patient with COVID-19 was able to transmit the SARS-CoV-2 to another patient in Germany [11].

Another possibility is that a super spreading "may be the result of increased interaction between the index case and other people, so an individual who has multiple and extensive social life is more likely to infect individuals than the person who has limited social interaction. Thus, it is imperative to practice social distancing to flatten the curve during an epidemic.

Children may be at higher risk of being asymptomatic and thus may shed the virus and cause infection in other people. However previous studies of SARS and MERS did not reveal a significant childhood infection, and one study of 1250 patients showed that pediatric cases 3.3% (in those < 10 years of age) and serologic assay showed a positivity rate of 0.1% in children compared to 0.7% overall positive rate [12].

Another possible contributing factor is variability in viral shedding. Super-spreading events were linked to extensive and prolonged viral shedding, and in sub-optimal infection control [13].

Additional factors that might also contribute to a superspreading event include prolonged duration of exposure, the practice of seeking care at multiple healthcare facilities, frequent inter-hospital transfer, and large numbers of contacts [14]. A higher viral load, more environmental contacts, and more interpersonal contacts, and a complex network of interactions made by individuals may also play further roles in superspreading events.

In conclusion, the occurrence of a super-spreading events had contributed to the transmission of SARS, MERS-CoV and SARS-CoV-2. There are multiple factors contributing to this event and include: immune suppression, increased disease severity and viral load, asymptomatic individuals, and extensive social interactions.

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